

Maturation and Spawning of *Bregmaceros mcClellandi* (Thompson)

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(With a plate and three text-figures)

The maturation and spawning behaviour of *Bregmaceros mcClellandi* (Thompson), a common gadid fish of Bombay, is studied for the first time. The structure of gonads and the stages of maturity have been clearly described. The season and periodicity of spawning is determined by ova-diameter measurements and distribution of maturity stages in different months. Fecundity or reproductive potential in relation to different variables is estimated and the equations for conversion found out. The minimum size at maturity is discussed. Ponderal index or condition factor, in respect of size and time, has been determined for both the sexes.

INTRODUCTION

The gadid fish, *Bregmaceros mcClellandi* (Thompson), locally known as 'Tengali' is quite common around Bombay. It occurs almost throughout the year and contributes about 3000 metric tons to the total annual fish landings made by mechanised and indigenous crafts at Bombay. Except for a short account on the food and feeding habits of this fish by Bapat & Bal (1952), very little information about its biology is available.

MATERIAL AND METHODS

The present study is based on observations of 2000 fish during a period of 18 months in the years 1962-64. The material was collected, once a week from the 'dol' net catches off the local fish-landing centres at Sassoon Dock and Versova.

The fish were properly cleaned, measured, weighed and sexed. The gonads were weighed and their colour and length, noted. A small part of each ovary was examined, microscopically, for determining the stage of maturity. The gonads were then preserved in 5% formalin, for further examination. The spawning habits were studied by direct observations on mature and spawning fish as well as by measuring the diameter of intra-ovarian eggs. Details of the method of study and discussion are included in the appropriate section of the paper.

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MATURATION OF GONADS

The seasonal changes in the development and maturation of gonads, was studied on the basis of arbitrary classification of maturity stages. The classification, which corresponds with the maturity stages adopted by the International Council for the Exploration of Seas, is based on observations, on the formation and extrusion of milt in the testes, and ova-diameter range and yolk-formation in the ovaries. Fish less than 50 mm. were indeterminate juveniles.

MALE

Immature	Stage	I	Testes in the form of thin thread-like strips of tissue. Crystalline-white in colour, and measuring about 3-5 mm. in length.
Maturing	}	Stage	II Testes slightly thick and compact. White in colour. Gonad length 5-9 mm.
		Stage	III Testes 9-16 mm. in length. Dorsal wall of each lobe with a prominent ridge. Milt formation commences.
		Stage	IV Testes much flattened and elongated (14-22 mm.). White to milky-white in colour. Milt oozes out on hard pressing.
Mature	}	Stage	V Testes quite large occupying more than 3/4 of the abdominal space. Milky-white in colour. Length 20-30 mm. Though turgid, there is no oozing of milt.
		Stage	VI More or less as Stage V. Milt oozes out on slightest pressure.
Spent	Stage	VII	No milt. Testes hard and dull-white in appearance.

FEMALE

(Plate I)

Immature	Stage	I	Translucent and faint-white ovary, with minute ova having a distinct nucleus and clear cytoplasm. Length and weight of ovary varying between 3-5 mm. and 10-18 mgm., respectively. Largest ova 0.183 mm. in diameter.
Maturity	}	Stage	II Ovarian lobes well-developed and asymmetrical (right shorter than the left). White to light-red in colour. Length and weight of ovary varies from 4-12 mm. and 15-45 mgm., respectively.
		Stage	III Ovaries gain in weight. Rosy in colour. A few large ova measuring up to 0.444 mm. in diameter. Yolk formation is in initial stages. Length and weight of ovary generally, varies between 6-17 mm. and 20-55 mgm., respectively.
		Stage	IV Ovaries containing rounded ova. Dark in appearance due to heavy yolk deposition. Peripheral part of ova having vacuolar appearance. Ovarian length and weight varies within the range of 9-21 mm. and 35-70 mgm., respectively. Largest ova up to 0.570 mm. in diameter.

Mature	{	Stage V	Ovaries appear more flattened and have a light-red coloration. Ova with evenly spread granulated yolk. Largest ova is 0.583 mm. in diameter. Length and weight of ovary in the range of 12-29 mm. and 65-270 mgm. respectively.
		Stage VI	Ovaries very much distended. Ripe ova free in ovarian space and occasionally come out through the oviduct. Ova heavily yolk-laden. Oil-globule absent. Dark and granular yolk frequently forming a central pasty core. Presence of a clear, colourless, fluid-filled perivitelline space. Length and weight of ovary varying between 15-35 mm. and 90-343 mgm., respectively. Largest ova measures 0.841 mm. or more in diameter.
Spent		Stage VII	Blood-shot, wrinkled and thick-walled ovary, containing a few residual ova.

MATURATION OF OVARIAN EGGS

The maturation of ovarian eggs, through different months, was studied by taking ova-diameter measurements of intra-ovarian eggs, in different stages of growth. The procedure followed was the same as that of Clark (1934). The measurements were taken with an Oculometer, giving a magnification of 1 m.d. = 0.07 mm. From each ovary, irrespective of its stage of maturity, 500-800 ova, on an average, were measured, and in all 300 ovaries, examined. The measurements were grouped at intervals of 5 m.d. each.

The maturation of intra-ovarian eggs takes place by striking changes in the size and structure of the ova. The oocytes are formed by proliferation of germinal epithelium of the ovary. The developing ova are borne on the ovigerous lamellae, traversing the ovary. The maturation of the oocyte is accompanied by the deposition of yolk-granules in the cytoplasm, therein transforming the tiny transparent oocyte into a big opaque ripe ovum.

The monthly variations in the percentage of ova-diameter measurements, as shown in Fig. 1, reveals that the intra-ovarian eggs begin to mature from December (56.04% of stage V ova) and further advancement in maturation continues up to May. Details of the progression, can be summarized as follows :

(a) In June, the ovary predominantly contains immature ova of size described under Stage I.

(b) In July and August, majority of ova are in the Stages II and III.

(c) From September to November, the ovaries contain ova of the size described under Stage IV.

(d) From December to May, mature and ripe ova of Stages V and VI are conspicuous. The ripe ova (Stage VI), first appear in January and subsequently their percentage goes on increasing till May.

The above-mentioned observations tend to show that the spawning season of *B. mcClellandi*, falls during the months of December to May.

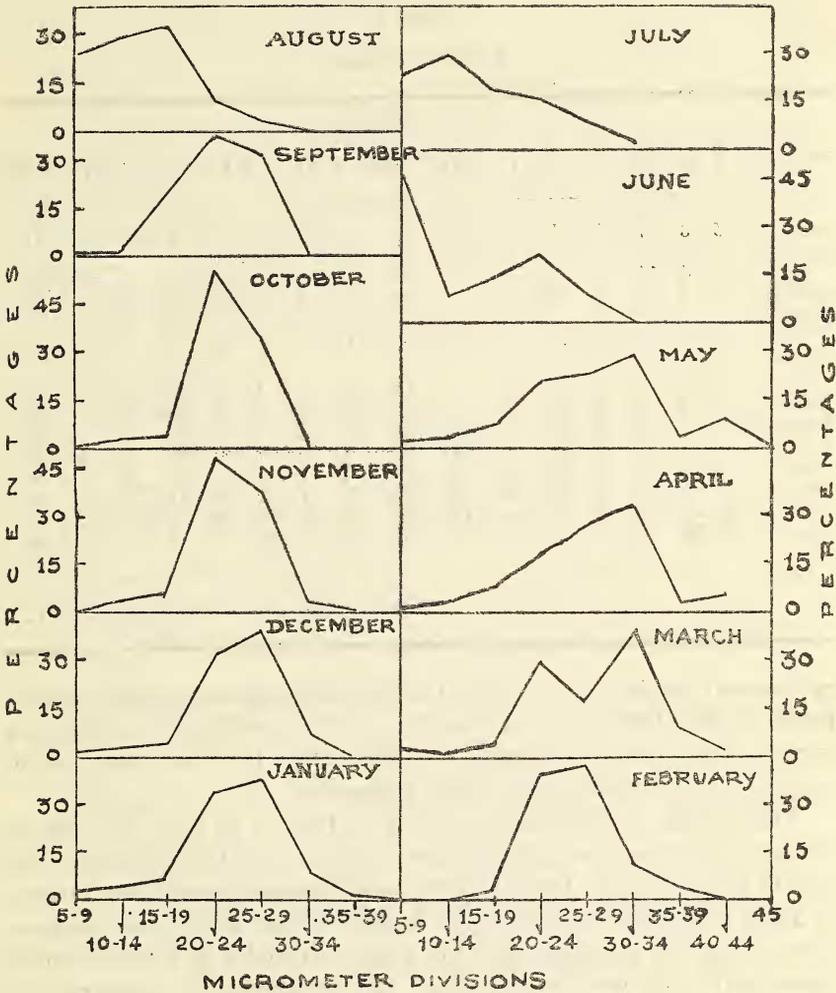


Fig. 1

SPAWNING SEASON

The spawning season of *B. mcClellandi* was determined by macroscopic examination of gonads in different months. Presented in Table 1 is the maturity stage-distribution data of males and females in different months,

Table 1 shows that the fish in Stage V occurs throughout the year in varying numbers and individuals in Stages VI and VII form low percentages. Such low occurrence of actual spawners and spent fish in the

TABLE 1

MATURITY STAGES

Month	♂							Total	♀							Total
	I	II	III	IV	V	VI	VII		I	II	III	IV	V	VI	VII	
August	5	8	7	3	1	—	—	24	7	11	10	2	1	—	—	31
September	2	4	11	19	7	—	—	43	2	4	12	22	9	—	—	49
October	1	4	5	36	23	—	—	69	2	5	5	42	29	—	—	83
November	—	2	3	20	17	—	—	42	1	1	3	25	25	—	—	55
December	3	—	2	23	38	5	—	71	2	1	1	14	22	2	—	42
January	2	3	3	43	66	6	—	123	3	—	2	50	85	14	—	154
February	1	1	4	34	58	7	—	105	2	1	2	21	36	5	—	67
March	—	1	1	11	36	7	1	57	1	—	1	13	41	6	2	64
April	2	1	1	5	34	2	2	47	2	1	—	7	39	4	1	54
May	1	1	2	7	29	6	5	51	1	1	1	6	31	5	3	48
June	17	3	11	12	7	—	18	68	23	4	11	16	5	—	17	76
July	19	30	15	7	5	—	—	76	21	27	18	15	8	—	—	89
															776	812

commercial catches may be due to the spawning migrations of the species. Bapat & Bal (1952) collected post-larvae of *B. mcClellandi* in plankton samples from fishing grounds, 5-8 miles away from the coast, which suggests the possibility of spawning migrations.

The number of individuals, as seen in Table 1 of both the sexes in Stage V, goes on increasing from October to May with the highest percentage (72.22%) in April. In June, there is a sudden decline in the occurrence of Stage V fish and it continues up to September. From these observations, it can be presumed that the Stage V females in October might spawn within the next two months. This presumption is supported by the appearance of Stage VI individuals in December. Although the number of such individuals is rather low, its very presence in the months of December to May indicates that *B. mcClellandi* has a prolonged breeding season, extending from December to May.

Spawning Periodicity :

The spawning periodicity in *B. mcClellandi* was determined by critically examining the distribution of ova-diameter frequencies in 20 ovaries, of which 12 were in Stage V and 8 in Stage VI, respectively.

A close examination of frequency polygons in Fig. 2, reveals that there are three distinct groups of ova, represented by modes 'a', 'b' and 'c', respectively. The mode 'a' at 5-9 m.d. represents the immature

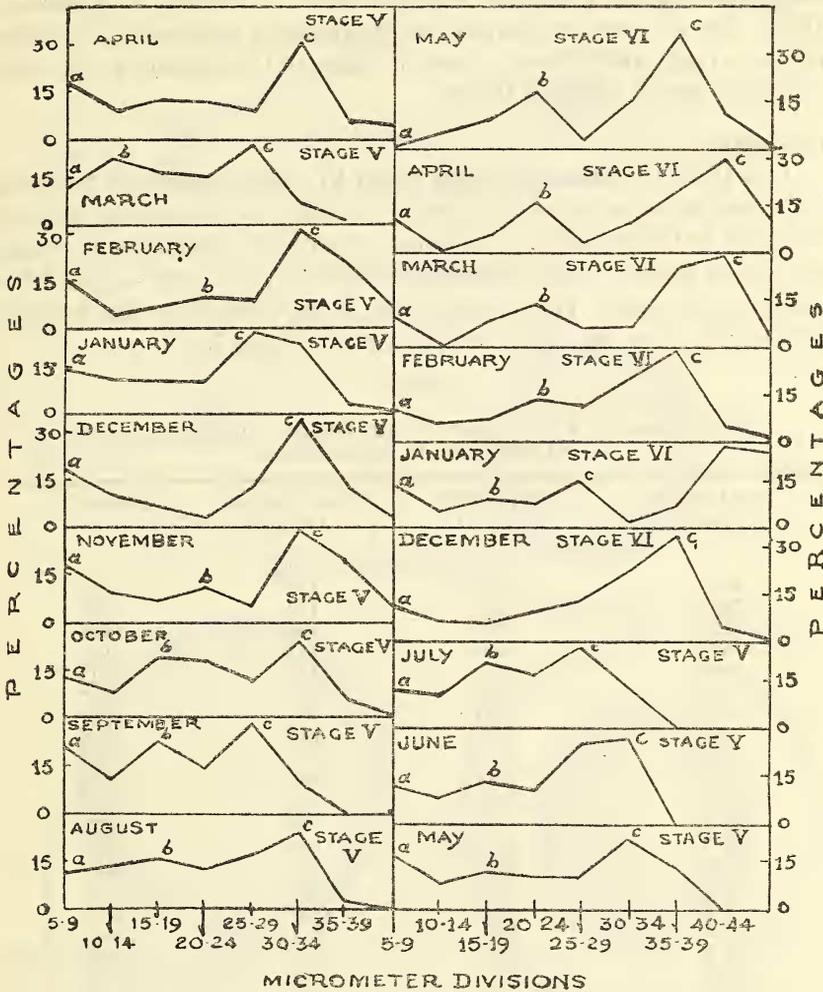


Fig. 2

stock. The maturing ova are represented by mode 'b' at 10-14 m.d., while mature ova (mode 'c') are spread within the wide range of 25-49 m.d. Thus the mature ova cover more than half the total range of intra-ovarian eggs.

Prabhu (1956) observed, 'in species, exhibiting the spawning of longer duration, the range in size of mature ova is nearly half the total range of intra-ovarian eggs of the entire ovary'. Hence, from ova-diameter measurements, it is evident that *B. McClellandii* has a prolonged

breeding season. Since the mature ova (mode 'c') are clearly differentiated from the immature and the maturing ones, it is clear that there is a definite periodicity in spawning and that the species may spawn in succession, during a definite breeding season (Hickling & Rutenberg 1936). By the time withdrawal of mature ova is effected, the other batches of egg attain maturity and are ready to be spawned, in the same spawning season (Prabhu 1956).

Fecundity :

Ova from 33 ovaries of Stages V and VI, were counted for assessing the reproductive potential and also to establish the relationship between fecundity and three different variables, namely, total length, body weight and gonad weight. The procedure of Bagenal (1957), was adopted for counting the eggs. The fecundity in *B. mcClellandi* varies between 1161 and 6015 and the details are as shown in Table 2.

TABLE 2

TOTAL LENGTH, BODY WEIGHT, GONAD WEIGHT AND FECUNDITY OF
33 SPECIMENS OF *B. mcClellandi*

Total length (mm.)	Body Weight (mgm.)	Gonad Weight (mgm.)	Fecundity
69.5	1919	110	3418
70.5	1214	119	2350
71.0	2056	139	1554
76.0	2089	143	1161
79.0	2764	172	2823
80.0	2950	103	2097
80.0	3144	93	1897
80.0	2494	143	2202
81.0	3073	175	3767
81.5	3143	260	3200
82.0	3081	147	2258
83.5	3119	169	4077
84.0	3514	154	2290
85.0	3465	169	2438
85.5	3852	256	3386
85.5	3580	220	4101
85.5	3584	297	4862
86.0	3697	139	4060
86.0	4354	365	4588
86.0	4404	213	2609
86.5	4033	342	3370
86.5	4182	229	4186
87.5	3649	204	3074
88.0	4314	324	3875
88.0	4230	222	4202
89.5	4869	204	3685
90.5	4536	286	4787
90.5	4814	234	4454
91.0	5220	148	2608
91.0	3894	224	3692
91.0	3974	194	2044
93.0	4599	378	3729
97.0	6054	343	6015

Plate 1

